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Analysis of Fifty Cases of
Croup treated by Intuba-
tion of the Larynx.

BY

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ATTENDING PHYSICIAN TO THE NEW YORK FOUNDLING
ASYLUM, ETC.

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No.	Date.	In consultation with—	Sex	Age.	DURATION, BEFORE INTUBATION, OF—		Urine.	Cause of death.	Complications before intubation.	Result.
					Croup	Pharyngeal diphtheria.				
51	1886. Dec.	Drs. Wallace and McLoughlin.	F.	9 y.	2 d.	10 d.	Not exam.	Inanit'n, paralysis.	...	Died 3 w. aft'r remov'l of tube
52	"	My own case.	M.	3 y. 3 m.	1 d.	Present.	No album'n.	Exten. to bronchi.	...	Died 3 d. 21 h. after intub'n.
53	1887. Jan.	Dr. O. P. Honegger.	F.	6 y. 5 m.	1½ d.	"	Not exam.	"	...	Died 5 d. 2 h.
54	"	Dr. J. M. F. Egan and Dr. J. P. Daly.	M.	3 y. 5 m.	1 d.	"	Albumin.	Not known.	...	Died 4 d. 14 h.
55	"	Dr. B. G. Cook.	F.	3 y. 4 m.	1 d.	"	"	Sepsis	A hopeless, septic case.	Died 17 h.
56	"	Dr. J. F. Holmes.	M.	4½ y.	3 d.	"	"	Pneumonia.	...	Died 9 d.
57	"	Dr. J. F. Holmes.	F.	2 y. 10 m.	1½ d.	"	"	Exten. to bronchi.	...	Died 1 d. 4 h.
58	"	Dr. J. H. Dew.	M.	3½ y.	1 d.	"	Not exam.	Pneumonia.	Extensive pneumonia, measles.	Died 62 h.
59	Feb.	Dr. Glück.	M.	4½ y.	1½ d.	None.	"	Exten. to bronchi.	...	Died 16½ h.
60	"	Dr. Hemingway.	F.	2½ y.	15 h.	3 d.	"	"	...	Died 14½ h.
61	"	Dr. Conrad Lange.	M.	2 y. 8 m.	4 d.	5 d.	Albumin.	Pneumonia.	...	Died 9 d.
62	Mar.	Dr. J. Lewengood and Dr. P. W. Crenin.	M.	3½ y.	3 d.	6 d.	"	...	...	Recov'd; wore tube 1 d. 1 h.
63	"	Dr. G. C. H. Meier.	F.	2½ y.	1 d.	None.	Not exam.	Exten. to bronchi.	...	Died 1 d. after intubation.
64	"	Dr. Robert Milbank.	F.	5 y.	2 d.	"	Albumin.	...	...	Recovered; wore tube 6 d.
65	"	Dr. Feigenblatt and Dr. Conrad.	M.	18 m.	1½ d.	4 d.	No album'n.	...	...	Recov'd; wore tube 4 d. 4 h.
66	"	Dr. Janvrin and Dr. C. E. Bilington.	F.	4 m.	2 d.	7 d.	Not exam.	Broncho-pneumo.	...	Died 1 d. 16 h. after intub'n.
67	"	Dr. S. Meltzer.	F.	8 y. 9 m.	4 d.	7 d.	"	Exhaustion	...	Died 1½ d. after intubation.
68	"	Dr. J. T. Deyo.	M.	3 y. 7 m.	2 w.	2 d.	No album'n.	...	...	Recov'd; wore tube 3 d. 21 h.
69	April.	Dr. H. Hermann.	M.	23 m.	3 d.	1 d.	Not exam.	Exten. to bronchi.	...	Died 1 d. after intubation.
70	"	Dr. R. B. Burton.	M.	2 y. 2 m.	3 d.	None.	No album'n.	"	...	Died 2 d. after intubation.
71	"	Dr. E. Elliot and Dr. A. Jacobi.	F.	19 m.	3 d.	"	Albumin.	Asthenia.	...	Died 2 d. 2½ h. after intub'n.
72	"	Dr. Berghaus.	F.	4 y.	3 d.	10 d.	"	Exten. & nephritis.	...	Died 2 d. 4 h.
73	May.	Dr. P. W. Crenin.	F.	4 y. 9 m.	3 d.	3 d.	"	Nephrit. & exhaust.	...	Died 7 d.
74	"	Dr. H. Bosch.	M.	5 y. 9 m.	1 d.	4 w.	"	Scarlet fever with diphtheria four wks. before.	...	Recov'd; wore tube 4 d. 10 h.
75	"	Dr. L. Burgheim.	...	7 y. 1 m.	12 h.	None.	No album'n.	...	...	Recov'd; wore tube 4 d. 10 h.
76	"	Dr. Rudisch.	F.	3 y. 1 m.	1½ d.	14 d.	Not exam.	Exten. & pneumo.	...	Died 2 d. 5 h. after intub'n.
77	"	Dr. Bleyer and Dr. Reid.	...	3 y.	1½ d.	None.	"	Exten. to bronchi.	...	Died 1½ d.
78	"	Dr. J. F. Curry.	M.	4 y. 9 m.	3 d.	4 d.	Not exam.	Heart failure	...	Recovered; wore tube 4 d.
79	"	Dr. J. Baran.	F.	4 y. 8 m.	1 d.	3 d.	"	Sepsis	...	Died 17 h. after intubation.
80	"	Dr. V. Mavlag and Dr. J. S. Green.	M.	3 y. 2 m.	2 d.	5 d.	Albumin.	Exten. & pneumo.	...	Died 1 d.
81	"	Dr. Vedder and Dr. Wilcox.	M.	7½ y.	1½ d.	2 d.	"	Nephritis, pneumo.	...	Died 1 d. 18 h. after intub'n.
82	July.	Dr. W. B. Anderton and Dr. A. J. Magnin.	M.	2 y. 5 m.	12 h.	2 d.	Not exam.	Exten. & pneumo.	...	Died 22 h.
83	"	Dr. E. Sanders.	M.	2 y. 5 m.	1 d.	2 d.	"	Pneumonia	...	Died 8 d. 19½ h.
84	"	Dr. R. Stein.	F.	16 m.	1 d.	2 d.	"	Exten. to bronchi.	...	Died 26 h.
85	Sept.	Dr. J. M. F. Egan.	F.	4 y.	4 d.	12 d.	Albumin.	Convulsions, exten.	...	Died 1 d. 22½ h.
86	Oct.	Dr. L. Conrad.	F.	5½ y.	2 d.	4 d.	"	Extension, nephritis, sepsis.	...	Died 1 d. 13 h.
87	"	Dr. A. H. Goelet.	M.	4 y. 5 m.	3 d.	Present.	"	...	...	Recov'd; wore tube 10 d.
88	"	Dr. Glück and Dr. Holthusen.	M.	5 y.	2 d.	None.	No album'n.	...	...	Recov'd; wore tube 5 d.
89	"	Dr. G. M. Vandegrift.	M.	2 y.	12 h.	6 d.	Not exam.	...	...	Recov'd; wore tube 3 d. 19½ h.
90	"	My own case.	M.	5 y.	1½ d.	Present.	Albumin.	Exten. & pneumo.	...	Died 6 d. 18 h. after intub'n.
91	Nov.	Dr. Daniel Lewis.	F.	4 y. 5 m.	3 d.	None.	No album'n.	Exten. & pneumo.	...	Recov'd; wore tube 6 d. 6 h.
92	"	Dr. P. H. Robinson.	F.	5 y.	1 w.	1 d.	Not exam.	Exhaustion	...	Died 1 d. after intubation.
93	"	Dr. W. H. Pyne.	F.	5½ y.	3 d.	Present.	Albumin.	...	...	Recov'd; wore tube 7 d. 21½ h.
94	"	Drs. J. B. and B. C. McIntyre.	M.	22 m.	1½ d.	1½ d.	Not exam.	...	...	Recov'd; wore tube 6 d. 21 h.
95	"	Dr. W. N. Guernsey.	F.	4 y. 2 m.	2 d.	3 d.	Albumin.	Sepsis, extension.	...	Died 1 d. after intubation.
96	"	Dr. H. J. Schiff.	F.	3 y. 2 m.	2 d.	Present.	"	Double pneum'nia	...	Died 9 d. 21 h. after intub'n.
97	"	Dr. A. Hodgman.	M.	6 y. 7 m.	3 d.	10 d.	"	Exhaustion	...	Recov'd; wore tube 3 d. 9 h.
98	"	Dr. C. E. Nammack.	M.	3 y.	2 d.	4 d.	Not exam.	Exten. to bronchi.	...	Died 3 d. 8 h. after intub'n.
99	"	Dr. C. H. Grube.	F.	4 y.	1 d.	2 d.	"	...	...	Died 2 d. 9 h.
100	"	My own case.	M.	9 y.	2 d.	Sever'd.	Albumin.	...	...	Recov'd; wore tube 4½ d.

No.	Age.		Recoveries	No.	Age.		Recoveries	No.	Age.		Recoveries
	Yrs.	Mos.			Yrs.	Mos.			Yrs.	Mos.	
1	0	4	0	2	2	6	0	2	3	6	1
1	1	4	0	1	2	8	0	1	3	7	1
1	1	6	1	1	2	10	0	3	4	0	0
1	1	7	0	2	3	0	0	1	4	2	0
1	1	1	1	1	3	1	0	2	4	5	2
1	1	10	1	2	3	2	0	2	4	6	0
1	1	11	0	2	3	2	0	1	4	8	0
1	2	0	1	1	3	3	0	2	4	9	1
1	2	2	0	1	3	4	0	2	5	0	2
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ANALYSIS OF FIFTY CASES OF CROUP TREATED BY INTUBATION OF THE LARYNX.

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IN the "Medical Record" of October 29, 1887, I published a summary of my first fifty cases of croup in private practice treated by intubation of the larynx. I also referred to the cases of sixty-five hospital patients who were operated on during the preceding five years while I was developing and perfecting the tubes and accessory instruments.

The following table comprises another series of fifty cases, also in private practice, treated during the past year, or from November 16, 1886, to November 18, 1887. Of several additional cases seen during the same period in which intubation was at one time considered necessary but that finally struggled through without operative interference, I will refer briefly to only two. Quite recently I was called in the night by Dr. E. Le Fevre to intubate a patient of his, a boy six years old, on the seventh day of croup. The stenosis was so marked that each inspiration suspended the pulse at the wrist, owing to the excessive quantity of blood sucked into the lungs. When I arrived the patient was somewhat better, and was still further improved by an

emetic of turpeth mineral. I watched him for over an hour, and left without operating. We believed that if we could get him through that night the danger, in all probability, would be over, as the disease had already lasted about the average length of time, and the early morning, which often brings some relief, was near at hand. The sequel proved that this view was correct, as there was no recurrence of serious dyspnœa. The voice in this case was good, notwithstanding the marked obstruction, and this, together with co-existing expiratory dyspnœa, proved the stenosis to have been subglottic. This patient was also seen by Dr. Jacobi.

Another case occurring in my own practice about the same time was that of a girl, aged seven years, in whom the larynx was invaded almost coincidently with the appearance of the exudation in the pharynx. Urgent dyspnœa lasted throughout the second night and up to noon of the third day, at which time I visited the patient with the intention of intubating. I waited for the effect of five grains of turpeth mineral, which acted promptly, and gave so much relief that the operation was postponed. Croupy cough, with loss of voice and occasional attacks of spasmodic dyspnœa, continued for a week longer, but operative interference was never necessary. The air was kept moist by a constant supply of steam carried under a sheet thrown over the head of the bed, the latter being very high and the temperature of the room at about 75° F. Dover's powder in doses of two grains was found very effectual in relieving the painful irritating cough and the spasm of the glottis to which it gave rise.

Both of these patients took the bichloride of mercury from the very inception of the disease, and I believe that if this remedy were administered in all cases of croup from the beginning, with proper care, a larger percentage of re-

coveries, both with and without surgical aid, would be the result.

In my own case gr. $\frac{1}{48}$, diluted with two teaspoonfuls of water, was given every hour, but this proved too irritating and gave rise to pain in the stomach and repeated attacks of vomiting when administered for less than twenty-four hours. It was therefore suspended for several hours and then given more largely diluted, without further inconvenience. It was again suspended for several hours on the fifth day, owing to the occurrence of two or three loose passages, and subsequently given in half the dose.

Dr. Jacobi, who also saw this case in consultation, says that gr. $\frac{1}{30}$ should be diluted in half an ounce of water, and larger doses proportionately. While preparing this article I was called to intubate a girl five years old, croupy less than twenty-four hours, who was taking gr. $\frac{1}{40}$ of the bichloride in tablet form placed on the tongue every hour. She was complaining of severe pain in the stomach, the cause of which was not suspected. I find that this is the most common method of administering this drug, and the only reason that it does not more frequently excite gastritis or gastro-enteritis is the fact that the stomach usually contains more or less food or drink, and generally of an albuminous nature. Given in such concentrated form on an empty stomach, it must prove highly injurious.

By referring to the following table it will be noticed that out of the fifteen cases intubated during the past autumn there were eight recoveries. This I attribute in part to the bichloride of mercury which was used in the majority of them, and in part to a less fatal type of the disease than prevailed last winter and spring.

CASE LI.—This case presents several interesting features. The patient was recovering from an ordinary pharyngeal diphtheria, the membrane having almost entirely disappeared, when

she was attacked with measles. The exudation reappeared in the pharynx and rapidly invaded the larynx. Dyspnœa recurred on the fifth day after intubation, and a very thick cast of the trachea was expelled immediately after the removal of the tube, with complete relief. Two days later I was sent for again and found her suffering from extreme dyspnœa, expiratory as well as inspiratory, but having a good voice. I recognized it as a case of subglottic stenosis and was prepared to use some force in reinserting the tube, which I found to be necessary. The tube was again removed in two days and there was no recurrence of the dyspnœa, but complete paralysis of the muscles of deglutition soon developed and it was found impossible to give any kind of nourishment by the mouth. Feeding by the rectum was resorted to as long as it could be borne, but the stomach-tube could not be used owing to the opposition of the ignorant parents, and the patient died from inanition almost three weeks after the final removal of the tube.

NOTE.—A boy, six years and a half old, seen with Dr. W. H. Hall, and intubated December 31, 1886, for the following reasons was not counted: On the second day following the operation he was progressing without an unfavorable symptom, but after my visit coughed out the tube. I had given particular instructions that in case this accident occurred there was no necessity for calling me as long as the breathing continued free. This advice often saves a hasty summons in the night, as in many cases the obstruction does not return for several hours after the rejection of the tube. On making my visit the next day, I found the patient moribund and reinserted the tube, but he never rallied. The struggle for breath had continued for about fifteen hours, and was fully recognized by those in attendance without any effort to notify me. I subsequently learned that the child was an orphan and probably very much in the way.

CASE LV.—This was a septic, hopeless case with such extreme tumefaction of the epiglottis and aryepiglottic folds that

it was difficult to locate the entrance to the larynx. The mother readily consented to the operation after being informed that there was no hope whatever of recovery, but that it would prevent death by slow strangulation.

CASE LVIII.—The patient had extensive pneumonia following measles when intubated.

CASE LXII.—This case is of interest as being the only one up to the present time in which I pushed down membrane in sufficient quantity to produce apnœa on the first introduction of the tube. As soon as it was removed by the string, which was still attached, a cast of the trachea was expelled, but the dyspnœa continued as before and reintubation gave complete relief. The tube was expelled in twenty-six hours and never needed again. With one exception, this is the shortest time the tube has been retained in the larynx with recovery in my own cases.

CASE LXXV.—It is not known how long the tube was retained in this case. Dr. Burgheim believes that it was expelled from the larynx and swallowed during an attack of vomiting within an hour after its introduction. It was certainly not in the larynx the next morning—inserted at 10.30 P. M.—as both cough and breathing were croupy with considerable dyspnœa, which continued with loss of voice for almost a week, but no further interference was called for.

This case is of interest as being only the second out of 173 cases so far in which the tube after escaping from the larynx and without any interference entered the stomach; also for the length of time—ten days—required for its passage through the alimentary canal. The tubes are so long that when the lower extremity leaves the larynx the upper extremity is in close proximity to the front teeth. This accident can, therefore, occur in only one of two ways: (1) Coughing it out during sleep or semi-consciousness, and (2) by being projected up behind the soft palate in the act of coughing or vomiting. In the latter case it must of necessity enter the œsophagus. It is quite possible that

some children intentionally swallow the tube in order to get rid of it and prevent its further use. I had one boy four years old who, with this object in view, dented the tube with his teeth. I have known others, on getting possession of the tube when no one was present, to throw it to a considerable distance or hide it where they supposed it would not be found.

I was recently requested by a physician who had had considerable experience with intubation to perform tracheotomy on a little patient of his for the purpose of removing a tube that had passed into the trachea. At the usual time repeated attempts to remove it were made without success. He possessed an unusual amount of coolness and dexterity, and was certain that he had not lacerated the larynx with the extractor, and I was equally certain that by no other means could the tube have entered the trachea. I found the patient suffering from extreme dyspnoea, which had recurred only after the last attempt at extraction, with croupy cough and croupy breathing, and, instead of opening the trachea, placed another tube of the same size in the larynx with complete relief. I then requested the physician to insert his finger and push it through if he could. This convinced him that the other tube was not in the trachea, and a more thorough search of the apartment resulted in finding it behind the bed, where the little fellow had concealed it, in all probability, several days before the attempt to remove it from the larynx had been made. This patient made a good recovery, notwithstanding the excessive irritation to which the larynx was subjected and the fact that he was obliged to take care of himself as best he could during the night, his parents being poor, hard-working people who could not lose their sleep and work during the day.

No doubt many cases similar to this have occurred, and it is not the first of this nature that has been reported. * It teaches the important lesson that the extractor should never be inserted until the head of the tube is distinctly felt by the finger. The swollen epiglottis and ary-epiglottic folds

may overlap its upper extremity even to the extent of producing serious obstruction in rare cases, but offer very little resistance to the entrance of the tip of an ordinary-sized finger, and one of extraordinary size should be used only in the less vital cavities.

CASE LXXXVII.—Before the removal of the tube, which was very much obstructed, on the fifth day the respirations were sixty-eight a minute, temperature 104.5° , mucous râles all over the chest, urine loaded with albumin. Marked cyanosis showed itself in ten minutes, and the tube was cleaned and reinserted with great relief to the breathing. It was again seriously obstructed, and the patient suffered from severe dyspnoea during the greater part of the night preceding its final removal on the tenth day. The relief was immediate and permanent.

This case shows the importance of warning the parents or nurse to notify the physician immediately on the return of any difficulty in the breathing. As soon as the lumen of the tube becomes seriously encroached upon, the cough ceases to be effective owing to the great reduction in the amount of tidal air, expectoration diminishes or ceases altogether, and the secretions accumulate in the air-passages. In the case just quoted the numerous moist râles heard over all parts of the chest indicated that a fair amount of air was entering the lungs, and yet when the tube was removed there did not appear to be one fourth of its caliber free. Loose secretions that can be blown out, or that will wash out by allowing a stream of water to pass through the tube, do not cause obstruction.

CASE XCVII.—I have already referred to several cases in which the retention of the tube for a few hours in the larynx relieved the dyspnoea for a considerable length of time. In this case it was retained on the first occasion for only five hours, and the dyspnoea was relieved for twenty-three hours. The same tube was then reinserted, instead of a larger one, in order

to favor its rejection again as soon as the pressure had reduced the swelling sufficiently to permit of this. This time it was retained sixteen hours, but had to be replaced in four hours. The third time it remained in the larynx nine hours, and the stenosis was permanently relieved. Had it not been expelled, I should have allowed it to remain in position about five days, instead of the thirty hours that it was actually required.

Besides the advantage of taking an ample supply of nourishment without difficulty that these intervals afford, it is the best means of getting rid of the tube at the earliest possible moment. There are still other advantages to which I have already called attention.

As a matter of course, nothing would be gained by using the same tube when the obstruction returns soon after its rejection. It is only in such cases as the foregoing, which are exceptional and very rare in young children, that this plan is advisable, except where loose membrane is known to exist below the tube.

I have already reported two cases in which the tubes suddenly became occluded with a cast of the trachea too large to pass through, and were promptly expelled.

I will briefly report the third accident of this kind in my experience where the tube was not expelled, and sudden death from apnœa resulted. It is not included in the table, and my object in referring to it now is to point out the means by which the accident may be avoided.

On the afternoon of November 25, 1887, I was requested by Dr. C. E. Bruce to see a little girl patient of his of delicate constitution, who had been croupy for only twenty-four hours. The tonsils were hypertrophied, and the mucous membrane presented the ordinary appearances of follicular inflammation, but no false membrane could be seen. As the dyspnœa was extreme, I immediately inserted the 5 to 7 tube, with prompt but not absolutely complete relief, such as always occurs when the obstruction is confined to the larynx. With the first cough I

recognized the existence of loose membrane below the tube. I had encountered the same thing so often before without accident that I had ceased to fear it, and removed the string as usual. The breathing soon became perfectly free, and she fell into a quiet sleep. The night was passed comfortably, and on the next morning we found her free from dyspnœa and in fair condition, but the loose membrane had not been expelled. In the evening, or about twenty-seven hours after intubation, during a violent attack of coughing excited by swallowing some lemon-juice, she suddenly choked, became deeply cyanosed, and died, the nurse says, in two or three minutes.

The tube used was two inches and a quarter in length, and, in girls of this age, will reach within about half an inch of the bifurcation. The presence of false membrane so near the bronchi and so early in the disease is usually a fatal omen. I therefore gave a very unfavorable prognosis.

About half an hour after death I removed the tube, and as I did so a distinct hissing sound of escaping air was heard by Dr. Bruce and myself.

This case, aside from its other interesting features, is of particular interest as demonstrating the mechanism by which acute general emphysema, or overdistension of the lungs with air, which is found in a small percentage of the fatal cases of croup, is produced. That portion of the pseudo-membranous cast lying loose in the trachea which extended below the tube acted in precisely the same manner as a very thin piece of rubber tubing drawn over the lower end of the tube, and about half an inch longer than it. This, while offering no obstruction to inspiration, would collapse on the first pressure from below, forming a perfect valve, and thus prevent any air from escaping. With a few forcible inspirations, without expiring, the lungs become inflated to their full capacity, and death, in all probability, takes place more rapidly than in the opposite condition of complete obstruction to the entrance of air with free exit,

because in the latter the carbonic acid is allowed to escape, while the residual air furnishes some oxygen to the blood.

Had this patient's chest been opened before the removal of the tube the lungs would have been found too large for their cavities, and containing less than the normal amount of blood, which was either squeezed out or prevented from entering by the pressure of the imprisoned air.

In order to prevent the accident that occurred in this case, where loose membrane was known to exist below the tube, several means may be resorted to; but the most important of these is using a smaller tube than that indicated by the scale of years. Had I, for example, removed the 5 to 7 size placed in this child's larynx and inserted the 3 to 4 size, which would have been perfectly safe, the chances would have been altogether in favor of its immediate expulsion, when occluded below, followed by a cast of the trachea, as the outward pressure of the abnormal amount of air in the lungs must have been very great.

Another precaution, and one which I have adopted in several cases, is leaving the string attached and fastening it behind the ear, so that the attendant can quickly remove the tube if necessary. It is objectionable on account of the irritation it produces and the difficulty of preventing the patient from removing it, or cutting it with the teeth. Clearing the trachea of false membrane with a suitable instrument would be the best safeguard against this accident, but it is useless to discuss it until its practicability has been demonstrated. Ticmann & Co. have recently constructed for me a set of membrane extractors which are introduced in the same manner as the tubes, and with the same instrument, but I have not had an opportunity to try them.

There is one other expedient that might prove effectual at the last moment in such cases as the foregoing, and in the

extrusion of foreign bodies from the larynx also. It consists in causing a sudden escape of some of the residual air, or, if respiration is not completely suspended, of the residual and tidal air, by taking advantage of the beginning of expiration. This is accomplished by placing the patient across the knees, on the floor, table, or other hard surface, and, while with one hand firm pressure is made on the abdomen to prevent descent of the diaphragm, the other hand, open, is brought down with considerable force on the front of the chest.

A slight cough has repeatedly proved sufficient to lift a metal tube weighing an ounce and three quarters from the adult larynx, and project it to some distance in front of the patient. The method just described accomplishes the same thing as the act of coughing.

The popular custom, so universally practiced, of striking a person on the back who is choking from a foreign body in the throat, can not have any appreciable effect in expelling air from the lungs, but if the blow were made on the front of the chest instead of the back, it would be attended with much greater success.

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